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(56) Documents Cited

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| GB 1466854 A | GB 1218806 A | GB 1048308 A |
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## (54) Explosion-suppressing barriers

(57) An explosion-suppressing barrier comprises a rigid support member such as a wall of polystyrene blocks 13. Each block comprises cavities 14 and each cavity contains a polythene bag 15 filled with water. Saddlebags 16, also filled with water,may be suspended over each course of the wall. In an alternative embodiment (figure 2, not shown), the blocks are solid and support the saddlebags. In a further embodiment (figure 1, not shown), a saddlebag is carried by a rigid support member which comprises a collapsible easel.

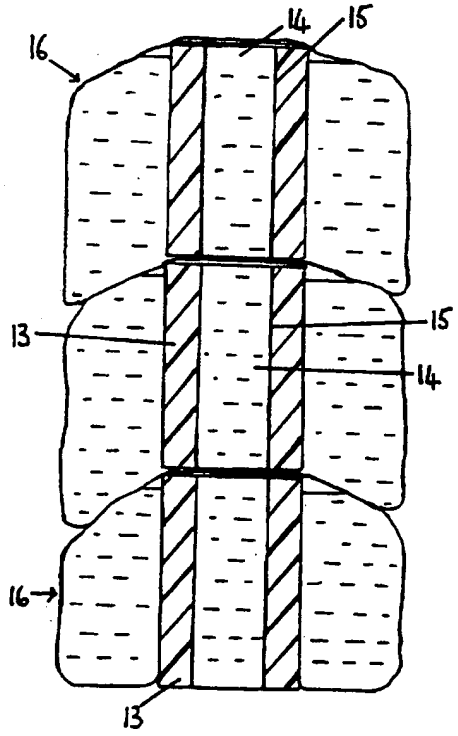


Fig.3

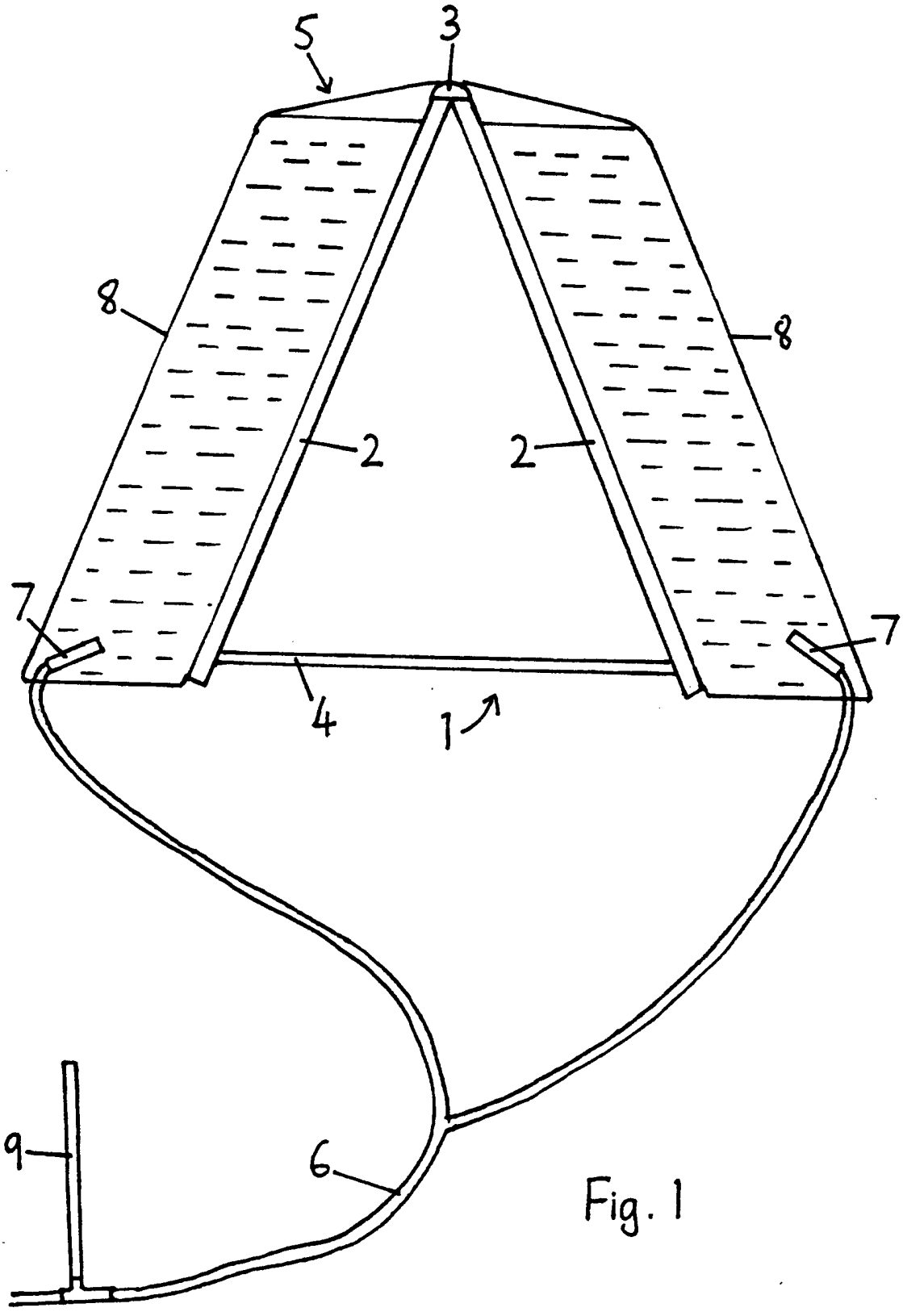


Fig. 1

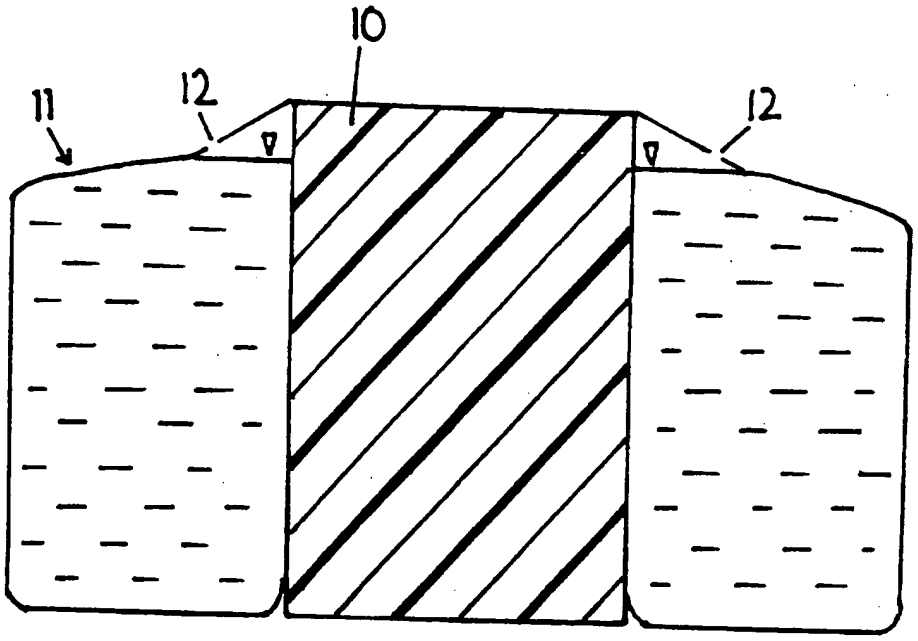


Fig. 2

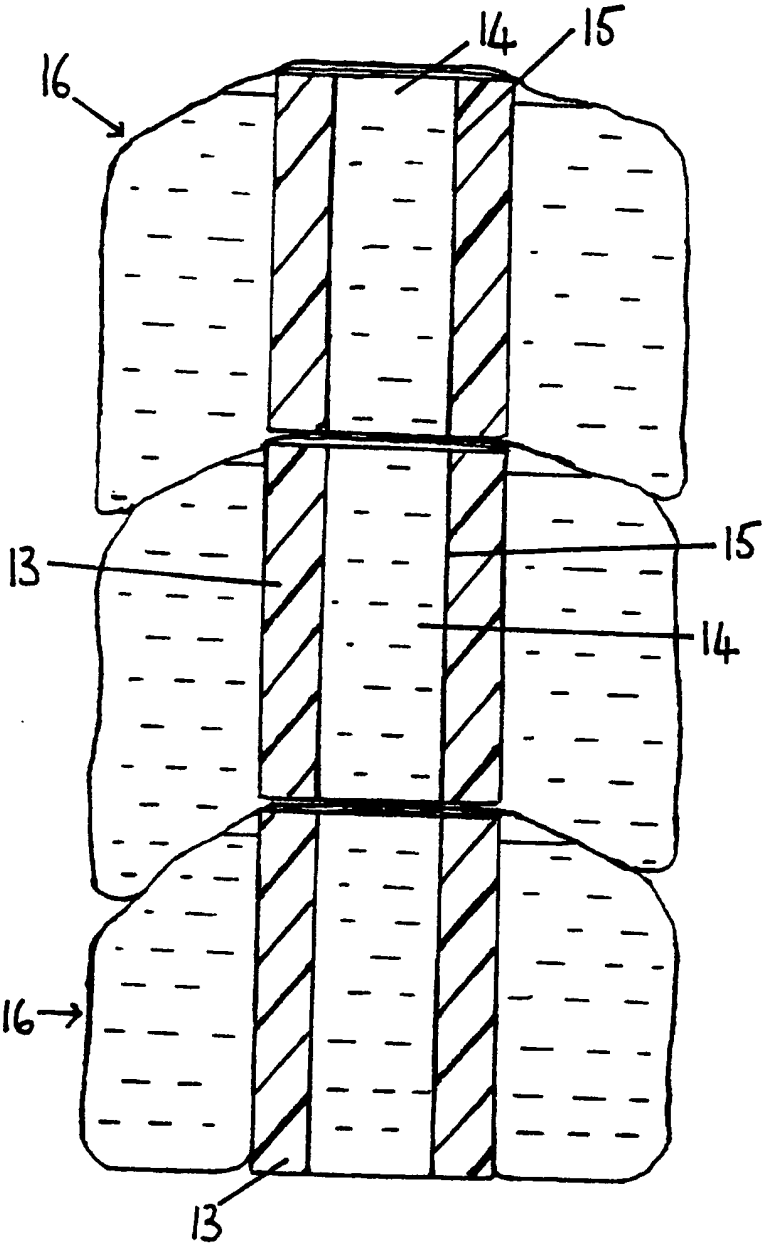


Fig. 3

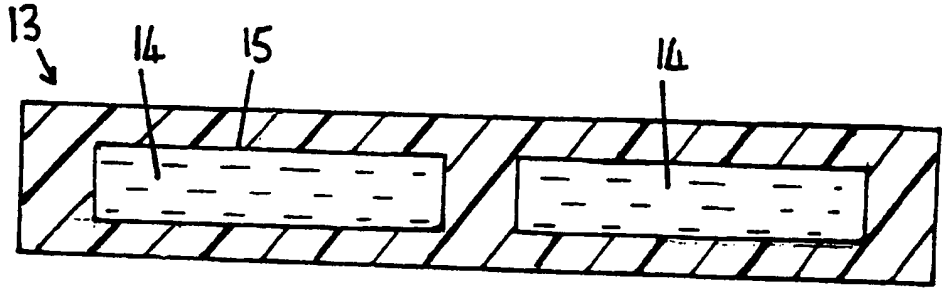


Fig. 4

# EXPLOSION-SUPPRESSING BARRIERS

This invention relates to barriers for suppressing the effects of explosions. The invention can be used to impede material ejected from explosions, particularly for the protection of persons or equipment from exploding shells, mines and bombs.

The present invention is a further development of the inventions disclosed in my International Patent Application No WO95/08749 and my British Patent Applications Nos 2,292,997 and 2,294,105 which describe aerozolizing liquid contained in rupturable containers.

The invention provides a free-standing explosion-suppressing barrier comprising a rigid support member defining or supporting at least one rupturable container filled with liquid which is aerozolized in use.

The support member may comprise at least one frame such as a collapsible easel or it may comprise a wall, such as a wall of polystyrene blocks.

In preferred embodiments of the invention a plurality of rupturable containers comprise bags which may be formed from layflat tubing of polythene or other plastic and which are preferably mounted on opposite sides of the support member.

An integral hose or manifold of flexible tubing may be provided for filling the container(s) with liquid.

In one embodiment, liquid is contained in cavities formed in elements of the rigid support member such as blocks of a wall.

The invention also provides a method of protecting a given location from the effects of an explosion, comprising

erecting a rigid support member between the given location and the site of the explosion, the support member supporting or defining at least one rupturable container filled with liquid which is aerozolized by the explosion.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic view, partly in section, of a barrier according to a first embodiment of the invention;

Figure 2 is a schematic sectional view of a barrier according to a second embodiment;

Figure 3 is a schematic sectional view of a barrier according to a third embodiment; and

Figure 4 is plan view of a block shown in Figure 3.

Figure 1 shows an easel 1 comprising two sections 2 of light timber hollow core door material, such as that manufactured by John Carr & Co of Leeds. Alternative materials which can be used for the easel include standard 50mm plastic plumber's piping and fittings. However, hollow core door material is less expensive and is therefore preferred, particularly since the barrier is destroyed in use.

The two easel sections 2, which in this example each measure 0.9m x 1m, provide the main supports of the easel 1. Each section 2 is cut at an angle along its upper edge and a length of half-round cardboard 3 is taped along the juxtaposed upper edges. The half-round cardboard 3 covers any sharp edges which could otherwise puncture the saddlebag described below.

Holes are drilled through the easel section 2 near

their lower ends, by means of which a polypropylene rope bracer 4 is tied between the sections. The bracer 4 maintains an optimum angle of 45° between the easel sections 2.

A saddlebag 5 is manufactured from polythene layflat tubing, preferably 760mm wide and 250μm thick but optionally of differing widths and up to 300μm thick. The upper limit to the size of the saddlebag 5 is determined by the weight of water which can be safely supported by the easel 1.

The saddlebag 5 is manufactured by welding closed both ends of a suitable length of layflat tubing. A branch of a filling hose 6, formed from 40mm or 50mm layflat polythene tubing, is connected in a liquid-tight manner to each end of the saddlebag 5 and one-way valves 7 are fitted at the ends of the hose 6 within the saddlebag 5. Two small vent holes (not shown) are formed in the saddlebag on either side of its centre line.

The saddlebag 5 is then draped over the easel 1, thus forming two individual bags 8, one on each side of the easel. The saddlebag is secured to the easel using double sided adhesive tape and the branched hose 6 is carefully rolled up and temporarily taped to the side of the easel 1.

Filling of the bags 8 takes place remotely via the hose 6 which is firstly unrolled and connected to a water tanker or mains water supply (not shown). A pressure limiter 9 ensures that the elements downstream therefrom are not ruptured. When the bags have been filled the barrier is as shown in Figure 1, at which point the hose 6, which is no longer required, can be removed. It will be appreciated that in order to form a barrier of suitable length, a number of easels 1 are placed end to end and a saddlebag 5 is draped over each easel.

In an alternative embodiment, not shown in the

drawings, which is suitable for use on sloping or highly uneven ground, the easel 1 of Figure 1 is laid on its side with the open end facing towards a munition to be exploded. Three saddlebags are draped over the easel, one over each section 2 and a third narrower saddlebag over the centre of the easel. Instead of the hose 6, the saddlebags are filled from a common manifold connected to the two outer bags in the open frontal region. The centre saddlebag is interconnected at its base to the two outer saddlebags both on the inner and outer sides of the easel. To facilitate even filling, further interconnections between the saddlebags are made through the easel sections. As the outer saddlebags fill, the centre saddlebag is automatically filled.

In a further alternative embodiment, the easel sections do not lean against each other but stand vertically. Holes are drilled both at the upper and lower edges of the easel sections. Polypropylene rope bracers are then tied to the sections using the holes, a first bracer connecting the upper hole of the first easel section to the lower hole of the second section and a second bracer connecting the lower hole of the first easel section to the upper hole of the second section such that the bracers cross and a "box" is formed from the easel sections. One saddlebag is suspended over each of the easel sections and the four individual bag filling points are all connected to a common manifold which is filled remotely from a hose formed from polythene layflat tubing.

The easels can be stacked flat for transportation and storage. Several hundred easels could be transported and stored in a 6 meter long container. For training purposes where explosives are not detonated, the easels can be re-used, however the polythene saddlebags and manifolds should be replaced after such use.

Figure 2 shows part of a wall of dense polystyrene

blocks. A practical size for the blocks is 2.5m long x 0.6m high x 0.4m wide and one such block is shown at 10. A saddlebag 11 is suspended over the block 10. This saddlebag is more simple than that shown in Figure 1 and is filled via two 45mm holes at 12 which are cut at suitable points equidistant from the centre. It is desirable that the two holes are at the same level and they are preferably at the highest practical point for filling each individual bag. If these criteria are satisfied, the individual bags will balance each other during and after the filling process and will permit retention of the maximum volume of water.

A number of blocks 10 are placed end to end, and a saddlebag 11 is suspended upon each block, in order to form a single course of the wall, a cross-section of which course is shown in Figure 2. Subsequently, a further course of blocks is laid on top of the first course and the process is repeated until a wall of the desired height has been constructed. A safe practical height for the wall is 2m, but greater heights can be achieved if two walls are built side by side and a header "tie course" is laid at right angles to bind the two walls together. Saddlebags are suspended both across the elevation and the gables of the header course, the blocks of which have straight cut ends.

The stretcher course is bonded by means of half blocks in a manner familiar to those skilled in the art of bricklaying. Blocks are manufactured with 45° angled ends to further assist the bonding process and to facilitate the construction of corners. Right angled corners are achieved in two stages, each of 45°, thus ensuring a uniform thickness of water.

The saddlebags suspended from each upper course of the wall overlap the saddlebags of the respective underlying course, which again maintains uniformity in the thickness of water presented at every point along the barrier. The saddlebags 11 of the lowermost course rest on the ground as

shown in Figure 2 and thus stabilize the wall.

Figures 3 and 4 show an alterative embodiment in which each block 13 of a wall comprises two cuboidal cavities 14 and each cavity contains a polythene bag 15 filled with water. In this example, the cavities 14 are bottomless, the bags 15 of the higher courses being supported by the saddlebags 16 of the respective underlying courses and the bags 15 of the lowermost course resting on the ground.

Alternatively, the cavities could be formed in the blocks by hollowing out from above, leaving a base for each cavity. In this case it is unnecessary to insert bags into the cavities, which can be filled directly with water.

The embodiments shown in Figures 2, 3 and 4 are particularly useful in situations where a building, aircraft or the like is to be protected from the effects of overpressure and heat resulting from an explosion at close proximity . The barriers of these embodiments break up in use and since they are made from polystyrene blocks, no damaging material is projected towards the protected item. Any metallic fragments from a shell or bomb (including an improvised vehicle bomb) strike the wall first and are arrested by the mass of water, their impact causing some of the water to be thrown into the air which in turn attenuates the following pressure wave.

In other situations it is desired to protect a structure, aircraft or the like from high velocity fragments, self forging fragments or the effects of a hollow charge. Accordingly, an alternative embodiment of the invention comprises a wall of water-containing blocks of a material heavier than polystyrene, such as polyurethane or glass reinforced plastic (GRP). Such blocks or tanks can be assembled in the manner of a masonry wall and it is even possible to incorporate such a wall into the actual structure of a building. Alternatively, this embodiment can

be used to protect large individual munitions or pods of smaller munitions from explosively driven fragments resulting from an accidental explosion adjacent to such munitions. This prevents a "domino effect" in which a denotating munition ejects fragments and causes other munitions to explode.

It should be borne in mind that a more solidly built barrier such as that just described can, if struck by a massive air overpressure wave, be physically translated against a structure or aircraft it is supposedly protecting, thus causing a possible collapse of the structure or trauma damage to the aircraft.

During the planning stage of a barrier according to the invention, the ultimate degree of protection required should be ascertained so that the appropriate barrier can be constructed. For example, in applications such as stopping or attenuating fragments and hollow and shaped charges, a water-filled wall may be used without the need to suspend saddlebags thereon. If, after installation of the barrier, a more serious threat becomes apparent, additional protection can be provided by constructing a second wall adjacent the first or by hanging multiples of saddlebags on the original wall.

CLAIMS

1 A method of protecting a given location from the effects of an explosion, comprising erecting a rigid support member between the given location and the site of the explosion, the support member supporting or defining at least one rupturable container filled with liquid which is aerozolized by the explosion.

2 A method according to claim 1, comprising the additional step of supporting further rupturable liquid-filled containers on said support member after erection thereof.

3 An explosion-suppressing barrier comprising a rigid support member defining or supporting at least one rupturable container filled with liquid which is aerozolized in use.

4 A barrier according to claim 3, wherein the support member comprises a collapsible easel.

5 A barrier according to claim 3, wherein the support member comprises a wall of blocks.

6 A barrier according to claim 5, wherein the blocks are of polystyrene.

7 A barrier according to claim 5, wherein the blocks are of polyurethane or glass-reinforced plastic.

8 A barrier according to any one of claims 3 to 7, comprising a plurality of rupturable bags of liquid.

9 A barrier according to claim 8, wherein bags are formed from layflat polythene tubing.

10 A barrier according to claim 8 or 9, wherein bags

are mounted on opposite sides of the support member.

11 A barrier according to any one of claims 3 to 10, wherein an integral hose or manifold is provided for filling the container(s) with liquid.

12 A barrier according to any one of claims 3 to 11, wherein liquid is contained in at least one rigid element of the rigid support member.

13 A barrier according to claim 12, when dependent upon claim 5, 6, or 7, wherein the rigid element(s) comprise(s) at least one of the blocks of the wall.

14 An explosion-suppressing barrier, substantially as described herein or with reference to Figure 1, Figure 2 or Figures 3 and 4 of the accompanying drawings.

Patent Office

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**Application No:** GB 9713514.9 **Examiner:** Trevor Berry
**Claims searched:** 1 to 14 **Date of search:** 15 July 1997

# Patents Act 1977
# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F3C (CP2, CPK): A5A (A37): B8K (KAA)

Int Cl (Ed.6): F41H, F42D

Other:

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| P, X | GB 2298911 A | PARKES. See support 3. | 3, 8-11 |
| X | GB 2289750 A | PARKES. Regarding rung 14, ladder 15 or wall as support. | 1, 3, 8-11 |
| X | GB 1536555 | NITRO NOBEL. See support C. | 1, 3 |
| X | GB 1466854 | FORREST. See support 1. | 3 |
| X | GB 1218806 | INSTITUT GORNOGO. See support 6. | 3 |
| X | GB 1048308 | WEISBERG | 3, 4 |
| X | EP 0276918 A1 | CUBE OVERSEAS. See figure 9. | 1, 3 |
| X | US 5394786 | GETTLE. See column 21 line 62 et seq | 1, 3 |
| X | US 3848794 | HOWELL. See figures 1 and 12 | 1, 3 |
| X | DE 3112729 A1 | MBB. See support 5. | 1, 3 |

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